STATISTICAL METHODS UTILIZED IN THE EVALUATION OF COMPANY FINANCIAL RESULTS

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Abstract

This paper is a practical study based on econometric analysis models that capture the causal link between the labor productivity and a company's probability to make a profit. The objective of this research was to identify the level and the evolution of the different variables that have an impact on the size of a company's profit.

Therefor we will use a database, divided into 4 types of enterprises, on their size and on the regression model with the dependent variable binary. Such a model can be interpreted as a way to model the probability that the dependent variable could.

Keywords: F*inancial Results, Labour Productivity,* Linear Probability Model, Probit Model, Logit Model

Introduction

In order to formulate the statistical laws we considered it necessary to process the data from over 2500 companies in the furniture industry, from our country, in 2008. We analyzed the way in which, the probability that a firm might have a profit, is influenced by the level and the evolution of the different variables that express a company's economic activity. We used as a database the companies that are classified into four categories, according to their size (according to the criteria issued by EUROSTAT) micro enterprises, small enterprises, medium enterprises and large enterprises.

The Econometric models used

Depending on the regression function used, we can build several types of regression models with the dependent variable binary.

The Linear Probability Model

The simple/multiple linear regression model with the dependent variable binary is called Linear Probability Model. It has the following general form:

$$Y = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + ... + \beta_k \cdot x_k + \varepsilon_i$$

Y is a binary variable such that:

$$\Pr(Y = 1/(X_1, X_2, ..., X_K) = \beta_0 + \beta_1 \cdot x_1 + ... + \beta_k \cdot x_k$$

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The regression coefficient β_1 expresses the modification in the probability that Y = 1, which is determined by the modification with one unit of X_1 provided that X_2, X_3, …,X_k are constant.
We similarly interpret $\beta_2,...,\beta_k$.

The estimation of the model's parameters is made using the method of the least squares and we can build confidence intervals and test hypotheses about the model's parameters.

The Probit Model

The Probit Model is a nonlinear regression model with the dependent variable binary. If we use a nonlinear function, the probabilities estimated by using the model, will have values in the interval [0,1], which is consistent with the probability concept. This condition is not guaranteed by the linear model which is an important limit to a such type of model.

The Probit Model for the multiple regression has the form:

$$\Pr(Y = 1/(X_1, X_2,..., X_K) = \phi(\beta_0 + \beta_1 \cdot x_1 + ... + \beta_k \cdot x_k),$$

where:

y is a binary variable;
is cumulative standard normal distribution function;
$X_1, X_2,..., X_K$ are independent variables.

The coefficients $\beta_1,...,\beta_k$ can be interpreted directly. We calculate the forecasted probability and the effect on it, of the modification of the independent variables.

The probability that y = 1, giving the valences $X_1,..., X_k$, is calculated by calculating the variable z.

$$z = \beta_0 + \beta_1 \cdot x_1 + ... + \beta_k \cdot x_k$$

From the table of the normal distribution, we can determine the probability, corresponding to the calculated value of z. If we calculate z for two values of a x_i variable, then we can estimate the modification in the probability, as a consequence of the modification of the independent variable x_i.

The Logit Model

This type of model is similar to The Probit Model, except that it uses the logistic distribution instead of the normal distribution. As The Probit Model, The Logit Model can be used to predict the differences between the probabilities of the different situations.
The Linear Probability Model is the easiest one to use and to interpret. This type of model does not capture the nonlinear nature of the regression function, provided that this nonlinearity exists. However this type of model provides an acceptable approximation in many situations.

The nonlinearity is captured both by The Probit and The Logit Models but the interpretation of the results is more difficult.

The Logit Model has the form:

$$\Pr(Y = 1/(X_1, X_2, ..., X_K) = F(\beta_0 + \beta_1 \cdot x_1 + ... + \beta_k \cdot x_k) = \frac{1}{\ell^{-(\beta_0 + \beta_1 \cdot x_1 + ... + \beta_k \cdot x_k)}}$$

The Logit Model is similar to The Probit Model, the only different thing is the distribution function used (profit / loss).

The information from the available database, allows the enterprises to merge depending on their financial result, profit or loss as follows (Table 1):

Table 1

The distribution of the enterprises according to the results

Type of enterp / Result	**Micro** number	**Small** number	**Medium** number	**Large** number	**Total** number
Profit	965	553	197	43	1758
Loss	594	137	59	17	807
Total	1559	690	256	60	2565

Source: the calculation was based on the sample

Based on the data from the table above, the graphic representation of the distribution of the entreprises according to the performance is, as follows

The micro enterprises have the lowest proportion with a 61.9% profit. The small enterprises have the highest proportion with a 80.1% profit. In total there are 1758 enterprises out of 2565 (about 68%) that have profits.

If we interpret the structures as empirical probabilities (the number of available observations allows this), then we can make the following observations:

- The number of the enterprises that make a profit is dominant on each category of enterprises;
- The probability to achieve profits reaches the highest level (80.1%) in the case of small enterprises;
- The probability to achieve profits is minimal for micro enterprises (61.9%).

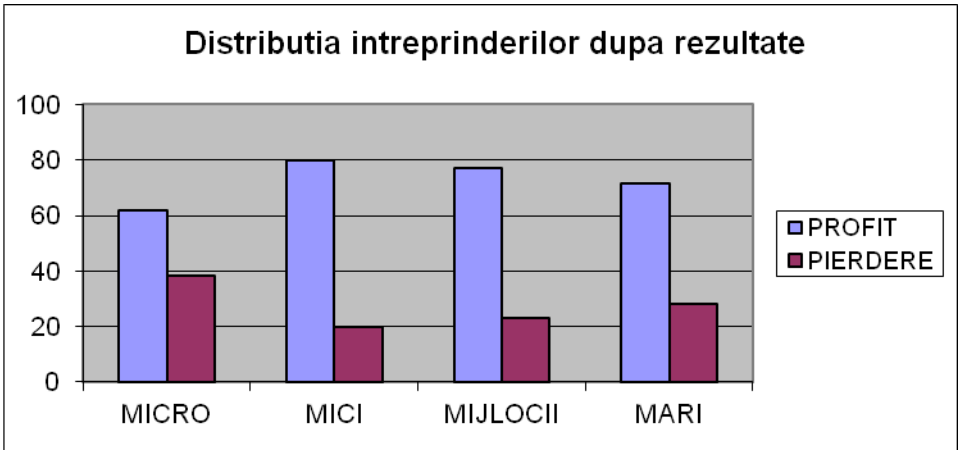

Figure 1. The distribution of the enterprises according to the performance

According to the available indicators we have also analyzed, the influence of the factors that have determined the probability that a firm can make a profit. We used a model with the dependent variable binary such as the Linear Probability Model. If we take into account the correlations between the variables we notice the influence of certain variables: turnover, material costs, wages costs etc. However, the models obtained, did not show, that, a firm's probability to make a profit, is based on these factors. Therefore, we used: labor productivity and inventory size.

LPM – productivity

Type of enterprise	Regression coefficient	F	Sig.	R^2	R
Micro	1,542E-6	52,782	.000	.033	.181
Small	1,096E-6	15,575	.000	.022	.149
Medium	2,063E-6	10,249	.002	.039	.197
Large	2,466E-6	2,932	.092	.048	.219

LPM - inventory size

Type of enterprise	Regression coefficient	F	Sig.	R^2	R
Micro	1,893E-8	1,385	.239	.001	.030
Small	2,642E-8	.397	.529	.001	.024
Medium	-5,414E-9	.052	.820	.000	.014
Large	4,566E-8	4,734	.034	.075	.275

Micro enterprises

Out of the 1559 micro enterprises sample, 61.9% had a profit and 38.1% had losses. We obtained the following results:

• the probability to make a profit based on labor productivity

$$Y = 0,558 + 1,54\ E - 6\ x$$
$$(37,649)(7,265)$$

where:

Y - the probability to making a profit;
x – the labor productivity.

The model is valid in statistical terms, with a 99% probability and the model's parameters are also significant for a 99% probability (p-value <1% for the both parameters). The model emphasizes the direct link between the labor productivity's level and the probability to make a profit.

• the probability to make a profit based on the size of the inventory.

$$Y = 0{,}619 + 1{,}893\ E-8\ x$$
$$(50{,}220) \quad (1{,}177)$$

where:

Y - the probability of making a profit;
x - the size of the inventory.

The model is not valid for a 95% probability (F = 1,385), and the regression coefficient is not statistically significant, for a 95% probability (p-value = 0,2394).

The regression coefficient's estimator does not comply the economic theory, the plus sign of the regression coefficient suggests a direct link between the size of the inventory and the probability to make a profit.

Therefore the probability to make a profit, increases if the labor productivity, also increases. In terms of productivity, the micro enterprises have a 0.5611 probability to make a profit. If the micro enterprises had the productivity of the large enterprises, the probability to make a profit would increase to 0.63.

Small enterprises

• the probability to make a profit based on labor productivity.

$$Y = 0{,}757 + 1{,}096\ E-6\ x$$
$$(38{,}902) \quad (3{,}946)$$

where:

Y - the probability to make a profit;
x – the labor productivity.

The model is valid in statistical terms for a 99% probability, and the model's parameters are significant for the same probability (p-value <1% for the both parameters). The model emphasizes the direct (positive) link between labor productivity's level and the probability to make a profit.

• the probability to make a profit based on the size of the inventory.

$$Y = 0{,}800 + 2{,}642\ E-8\ x$$
$$(45{,}0234) \quad (0{,}630)$$

where:

Y - the probability to make a profit;
x - the size of the inventory.

The model is not valid for the 99% probability, nor for a 95% probability (significance F = 0,5290).

Also, the regression coefficient is not significant, different from zero (p-value = 0.5290). As in the previous case, the results are not consistent with the theoretical model. The estimator for the regression coefficient shows that if the inventory grows, the probability to make a profit, should increase as well. Therefore the probability to make a profit does not depend on the size of the inventory.

Medium enterprises

• the probability to make a profit based on labor productivity

$Y = 0,676 + 2,06\ E - 06\ x$
(17,361) (3,201)

where:

Y - the probability to make a profit;

x – the labor productivity.

The model is valid for a 99% probability (F = 10.2489) and the both parameters of the regression model are significantly different from zero. Therefore we can say with a very high probability, close to one, that the probability to make a profit depends on, in a direct relationship, the labor productivity.

• the probability to make a profit based on the size of the inventory.

$Y = 0,775 - 5,4\ E - 9\ x$
(21,726) (-0,228)

where:

Y - the probability to make a profit;

x - the size of the inventory.

The model is not valid, and the parameters are not different from zero for a 99% or a 95% probability. We notice that the regression coefficient is consistent with the theoretical model (the minus sign of the regression coefficient shows that if the inventory grows, the probability to make a profit decreases).

Large companies

• the probability to make a profit based on labor productivity.

$Y = 0,587 + 2,466\ E - 6\ x$
(6,147) (1,712)

where:

Y - the probability to make a profit;

x - labor productivity.

The model is valid for a 90% probability (Significance F = 0.092), and the model's parameters are also significant for the same probability. We can say with a 90% probability that the probability to make a profit is determined by labor productivity's level.

• the probability to make a profit based on the size of the inventory

$Y = 0,623 + 4,566\ E - 8\ x$
(8,714) (2,176)

where:

Y - the probability to make a profit;

x - the size of the inventory.

Although the model and parameters are statistically significant for a 95% probability, we can not accept the results because they are not consistent with economic theory. The plus sign of the regression coefficient, shows that if the size of the inventory grows, the probability to make a profit should increase as well.

Conclusions

The labour productivity, and its growth is a major channel that generates profit for any type of enterprise.

If we look at the size of the regression coefficients of the model that explains the influence of the labor productivity on the probability to make a profit we can see the connection between the company's size and the intensity of this influence.

In all the cases, if it is consistent with the economic theory, the regression coefficient will show a direct link between the size of the labor productivity and the probability to make a profit.

This statistically valid link, for any type of enterprise, suggests that the management of the enterprise should pay more attention to the labor productivity.

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